

The digital factor

How Germany benefits from smart technologies



A study
commissioned
by Google
Executive Summary

Information on the study

Digital technologies and AI offer great potential for the economy and society. They can stimulate entirely new fields of activity and economic sectors, lead to innovations and strengthen social participation. At the level of individual economic stakeholders, the potential arises from the possibility of optimising and automating processes and thus using existing resources more efficiently. Against this background, the study commissioned by Google analyses the relevance and potential of digital and intelligent technologies in general and artificial intelligence in particular for the economy and society in Germany. The analysis and the resulting conclusions and recommendations for action are independent of the commissioning party.

In over 25 years of company history, Google has developed into one of the leading technology companies worldwide. Google's diverse services contribute to the digital transformation in companies and in society. Within the scope of this study, a focus is repeatedly placed on the use of Google's services in business and society and analysed as to how this contributes to the digital transformation.

The derivations of the study have a broad methodological basis from online surveys, case studies and the use of secondary data or literature. Here is a more detailed explanation of the methodological basis:

Online surveys:

As part of this study, a representative company survey among 2,068 companies in Germany and a representative population survey among 1,012 people in Germany on the use of digital technologies, Google services and AI were conducted in June and July 2023. The surveys serve as the main source of information for the study. To apply them to the respective population, they

were calibrated by weighting. This means that the results also apply to the overall economy or the overall population.

Modelling:

Building on the existing literature (Briggs/Kodani, 2023) and Public First's calculations on the economic potential of AI as well as the economic impact of digital technologies and Google services in particular, the current economic impact and future lines of development through the use of AI and digital services are shown.

Secondary data:

A variety of public information sources are used to place the survey data in the economic context. These include, for example, the business register (Federal Statistical Office, 2023) or publications from Eurostat.

Case studies:

In addition to the extensive surveys and modelling, case study interviews were conducted with selected company representatives who have gained extensive experience with the use of Google services in the recent past. The case studies serve to provide a better understanding of the usage experiences of companies using Google as well as to exemplarily enrich the number-based analyses.



The study itself and an overview of the methodology used are available from:
der-digitale-faktor.de



Executive Summary

Generative artificial intelligence (AI) could contribute € 330 billion to Germany's gross value added in the future.

This figure reveals just how important the deployment of AI will be over the next few years in securing the competitiveness of German businesses. As one example, the utilisation of generative AI tools could result in a significant increase to productivity. **An employee in Germany could be saving an average of 100 hours a year as a result of these applications.¹**

Although the general public has become aware of AI only recently, these technologies have been of interest to entrepreneurs and policymakers alike for some time. Since 2019, AI has been a key agenda item for European industrial policy (European Parliament, 2020), with the German government also publishing its National Strategy for Artificial Intelligence in 2018 (German Federal Government, 2018). The proportion of companies actively deploying AI has been steadily increasing (Rusche et al., 2022). **A recent estimate suggests around 600,000 companies are now using AI in Germany, which would equate to around 17 percent of all German businesses.**

The use of AI is directly related to business success: while 19 percent of companies using AI have recorded a growth in their workforce, the same is true of only 6 percent of companies that have yet to start using AI. Furthermore, companies that are able to deploy AI in product or service innovations also exhibit the greatest level of success in terms of workforce and revenue growth.

In order to fully exploit the value creation potential of € 330 billion, more than 50 percent of companies must use AI. Some 40 percent of companies have stated that they are likely to be

increasing their use of AI within the next 12 months. Over the next five years, 46 percent of businesses are planning related investments with the aim of having AI complete tasks currently handled by human workers. Businesses are also looking to make good use of this freed-up human capital: within the stated timeframe, two in three companies consider it likely that they will be able to employ their staff for tasks that generate greater value. Businesses are also looking to hire staff who can provide support in the development of AI applications (45 percent) and also intend to upskill their employees in this field (41 percent). These results further corroborate analyses of the consequences of AI for the labour market carried out to date, which do not reveal any negative impact on employment (Acemoglu et al., 2022).

Employees also see AI as offering potential for their own work: 75 percent of the workforce thinks that generative AI tools will help them to achieve greater productivity.



100

hours a year could an employee in Germany be saving as a result of the utilisation of generative AI



Around **600,000**

companies are now using AI in Germany

¹ Based upon Goldman Sachs' identification of the types of tasks exposed to automation by generative AI (Briggs/Kodani, 2023), Public First produced new estimates of the potential improvement in labour productivity. Further information on assumptions and requirements to be met in order to leverage the potential can be found in the full study at der-digitale-faktor.de

Digital technologies help to secure the German business model

In light of the worsening problem of skills shortages resulting from demographic change, making the most of the potential productivity offered by AI will be decisive in ensuring that Germany stays both competitive and prosperous. For the German economy in particular, with its strong manufacturing sector, the digitalisation of products, processes and business models is a key step to take as it seeks to achieve the transition to a new era. Integrating the excellent level of engineering expertise in Germany with this new digital know-how (following the advanced systems engineering² approach) is a precondition for maintaining the future competitiveness of German manufacturing companies.

As an economy, Germany's business model is based on a strong manufacturing base, a high level of innovation from small and medium-sized enterprises, and the decentralised, urban and rural distribution of economic actors. Compared with other countries, Germany exhibits a more equal distribution of businesses, characterised in particular by the 'hidden champions' based in rural locations, which provides job security and prosperity virtually nationwide. Digital technologies are already working to entrench this decentralised advantage. One example is the use of cloud-based solutions to compensate for the 'friction of distance' in rural areas, which allows companies located there to be similarly innovative to companies that are based in urban innovation hubs. This digital translation process needs to be pursued further.

Alongside the transformation of established companies, improved general conditions also need to be created for digital start-ups: these not only have a dynamic effect on Germany's economic structure in general but also provide important innovative stimuli for established businesses.

Manufacturing using digitalisation and AI to strengthen competitiveness

To secure the future competitiveness of German manufacturing and the nation's status as a global player, a further increase in the country's high productivity is required: some 20 percent of gross value added in Germany can be attributed to the manufacturing sector. Currently, Germany's productivity is rated around 14 percent higher than those of its European neighbours. Productivity growth, however, has declined in recent years, with a negative trend now developing in some segments within the manufacturing sector (Schröder, 2022).

German manufacturing is closely integrated with the service sector. Alongside the sale of machinery, manufacturing businesses often provide accompanying services such as maintenance or logistics. These same companies also purchase services themselves, from IT to facility cleaning. Considered together, this manufacturing/service cluster contributes a third of total value added – much more than would be assumed for manufacturing alone. This is a strong cluster in Germany that opens up potential for AI applications. The digitalisation of machinery generates a wealth of real-time data, which AI is capable of analysing in order to optimise processes and create data-driven business models.

In manufacturing, the proportion of companies utilising AI is 31 percent – double the number found in the service sector. Manufacturers primarily utilise AI to automate their internal systems (27 percent) and therefore use it directly within the production process. Other application scenarios include customer support and automated information searches (each at 23 percent). During the last year, 88 percent of manufacturers actively utilising AI posted a

positive profit margin, compared with only 69 percent of manufacturing businesses who have decided against the deployment of AI tools.

Manufacturers are also benefiting from the use of Google Cloud alongside AI: some 70 percent of manufacturing companies using Google Cloud state that Google's solutions are boosting business performance. This figure compares with only 39 percent of manufacturers who do not make use of Google Cloud. Google Cloud is therefore a decisive tool for improving competitiveness: **on average, manufacturing businesses that use Google Cloud are more likely to be innovators (90 percent versus 45 percent),** and more likely to post revenue growth (31 percent vs 21 percent) and workforce growth (28 percent versus 18 percent).

Cloud solutions are also helping manufacturers to network their machines together and therefore increase their level of process automation. Google Cloud also gives companies access to easily deployable AI tools. **Among manufacturers using Google Cloud, 90 percent utilise AI applications** to analyse data and explore new business models, while this is true for only 20 percent of businesses who do not use Google Cloud. Given the ongoing skills shortage, which is especially prevalent in IT, intuitive solutions for the use of AI tools with low barriers to entry are especially valuable.

31%
of companies in manufacturing are utilising AI

90%
of manufacturers using Google Cloud utilise AI applications

2) Advanced systems engineering focuses in particular on the impact of increasing digitalisation, interdisciplinarity and networking on mastering the technical and organisational complexity in engineering applications of the future.





One in three SMEs states that Google has helped them pursue the deployment of digital technologies

A medium-sized company saves around **€ 270,000** on average by using applications such as Google Workspace

SMEs benefitting from AI-assisted Google services

In Germany, more than 99 percent of businesses have fewer than 250 employees. Together, these small and medium-sized enterprises (SMEs) are the foundation on which the German economy is built. Compared with major corporations, these businesses often experience lower levels of productivity and innovation. SMEs achieve an average productivity of around € 47,000 (gross value added per person employed), for example, while productivity is around € 80,000 in companies with more than 250 employees (German Federal Statistical Office, 2023).

Scaling effects are also seen in the deployment of AI: while only 16 percent of companies having fewer than 250 employees actively use AI tools, this figure is 75 percent for large companies in Germany. This makes it even more important that AI's potential becomes more widely utilised by small and medium-sized enterprises. Google

Cloud is helping to make this happen: some 30 percent of SMEs who use Google Cloud also utilise AI tools, compared with only 14 percent of SMEs who are not using Google Cloud services.

Beyond Google Cloud itself, small and medium-sized enterprises are also using Google services to automate and digitalise their processes. **One in three SMEs states that Google has helped them pursue the deployment of digital technologies within their business.** Google Workspace³ in particular is promoting the spread of digitalisation within SMEs: here, 52 percent of businesses state that Google has helped them push forward with their deployment of digital technologies. **Thanks to easier collaboration, and its streamlining of processes and workflows, an average SME can save around € 270,000 every year by using applications like Google Workspace.**

3) Google Workspace: https://workspace.google.com/intl/en_uk/features/

Companies in rural areas overcoming fraction of distance

Germany has a characteristically decentralised economic structure that is based on the homogeneous distribution of its various enterprise hubs. Rural and urban areas alike are home to companies who are not merely profitable but also international leaders in their respective markets. In the case of Germany's many 'hidden champions', their remoteness from urban hubs has proved no barrier to their global market leadership.

As the digital transformation has taken shape, companies in rural locations have faced particular challenges: the available digital infrastructure is often sparser compared with urban spaces, suitably-qualified personnel are scarcer, and innovative ventures with research institutions and business networks are harder to get off the ground.

For companies in rural areas, digitalisation offers many opportunities for overcoming these obstacles. Here too, the usage of AI tools has a positive impact on business success: over the last year, the proportion of businesses in rural locations using AI tools who were able to achieve a positive net yield on sales amounted to 67 percent. In comparison, the corresponding figure was only 54 percent for those companies in rural locations who have decided not to deploy AI technologies.

Opportunities for online sales and marketing in particular also offer businesses a chance to expand their comparatively small local customer base, and therefore overcome the problems resulting from their remoteness to large population centres. More than half of companies based in rural areas make use of the opportunities offered by online sales – from either their own website or a third-party provider. This proportion is as high as that found in urban areas. A similar picture is found in the case of online advertising: 55 percent of companies in rural areas use online advertising with the aim of

reaching potential customers. In urban areas, this figure rises to three quarters of all businesses.

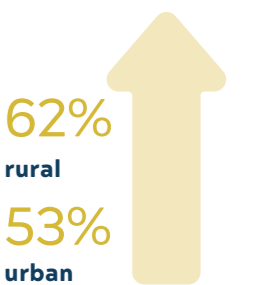
Yet online advertising and sales can provide a significant competitive advantage to companies in rural areas in particular: **compared with companies who do not use online ads (9 percent), rapid growth⁴ is enjoyed by almost twice as many rural companies (17 percent) who advertise online.** For urban businesses, this gap is significantly less substantial: 10 percent of companies who advertise online post rapid growth, compared with 8 percent of companies who do not use online ads.

Google's advertising services⁵ play a significant role here: among rural businesses who make use of online marketing, almost half deploy Google advertising services as part of this strategy. When comparing the pace of growth among companies based in rural locations, the difference seen between those who make use of Google advertising services and those who do not is more pronounced than in the case of urban businesses: in rural areas, 20 percent of Google advertising services-using companies experience rapid growth, compared with only 11 percent of businesses not using it. The corresponding figures for urban firms are 12 percent versus 8 percent.

Alongside options for online sales and marketing, the use of cloud services also offers companies based in rural areas the chance to overcome problems resulting from their distance to urban centres. While companies in urban areas are less innovative than businesses in urban spaces on average (44 percent versus 53 percent), this difference disappears when Google Cloud is deployed: **in fact, a greater proportion – 62 percent – of companies in rural areas using Google Cloud are considered innovative, compared with urban companies (53 percent).**



Twice as many rural companies who advertise online enjoy rapid growth, compared with companies who do not use online ads



A greater proportion of companies in rural areas using Google Cloud are considered innovative, compared with urban companies

4) In this study, 'rapid growth' is defined as revenue growth of more than 10 percent in the last reporting year.
5) Google advertising services include Google Ads, YouTube Ads and AdSense.

The aggregate Google effect in Germany: Estimated € 53 billion value creation and 860,000 jobs

The results show that the digital transformation is vital for the further development of Germany's characteristic economic model. More and more products, processes and business models are based on digital technologies – which also have a positive impact on the ability to innovate. Google has become a key driver for steering this transformation: 90 percent of all companies in Germany use Google's AI-powered services and benefit in this way from the potential offered by digitalisation and the deployment of AI.

Google services facilitate revenue growth in particular thanks to the new (international) sales markets that can be opened up by the use of Google Ads. **Some estimated 40 billion of the € 53 billion of gross value added created by Google in Germany are the direct result of Google Ads and Google Search.** On average, a single euro spent by companies on Google Ads will increase their revenue following this ad spend by eight euros.⁹

The use of Google's services contributes to business success: around a third of companies that use at least one product from Google were able to achieve revenue growth last year, compared with only half of those companies who do not use any Google services. Google helps German companies both in domestic and international markets: over the last year, businesses were able to achieve exports totalling estimated € 12 billion in 2022, thanks to the use of Google Search and Google Ads.¹⁰

In 2023, at least €53 billion of gross value added in Germany are estimated to be attributable to the use of Google services,⁶ corresponding to 1.5 percent of total value added in Germany.⁷ **Google services are therefore estimated to form a foundation for 860,000 jobs in Germany and thus more than 2 percent of the German workforce.**⁸ These services contribute in many ways to improving Germany's status as a global economic player while strengthening the social fabric in Germany. Almost 70 percent of the companies using Google Ads, Google Business Profile and Google Maps consider these services important for their business activities, with around half of all companies respectively stating that they use Google's services to drive growth and develop their business.

6) This figure is the sum of estimates for gross value added across six Google services: Google Ads and Google Search, AdSense, Android, YouTube and Google Cloud. The calculations are based on the methodology of the US Google Economic Impact Report (Google Economic Impact, 2023), the results of studies on value creation through Google Cloud (Implement Consulting Group, 2023), and calculations by Oxford Economics on the economic, social, and cultural benefits of YouTube in Germany. Gross value added comprises the added value created in the production process after deducting intermediate inputs. Gross value added is valued at basic prices, i.e. excluding taxes payable on goods (taxes on products), but including subsidies on products (Federal Statistical Office (2023)). The calculations were carried out by Public First. A detailed description of the methodology can be found in the full study at der-digitale-faktor.de

7) Since the data for total gross value added in Germany as a whole is only available up to 2022, the total gross value added of €3.5 trillion in 2022 is used as a reference.

8) The estimated number of jobs supported by the the corresponding gross value added figure is based on the ratio of gross value added to employed persons in Germany (Federal Statistical Office, 2023). In addition, results of Oxford Economics on the economic, social, and cultural benefits of YouTube in Germany, and results of the study by Implement Consulting Group (2023) on the effect of using Google Cloud, are used. The calculations were carried out by Public First.

9) The 8:1 ratio represents the return on investment (ROI) from Google Ads. This means that one euro invested in advertising spending on Google Ads was subtracted from the revenue growth achieved. The methodology is based on the approach used in the US Google Economic Impact Report. The 8:1 ratio is made up of two components: additional business revenues achieved via Google Ads and those achieved via Google Search. For each euro invested, additional business revenues via Google Ads amount to €2 and additional business revenues via Google Search amount to €7. After subtracting the invested euro from the additional total revenues, the ROI is €8. These estimates are mainly based on academic studies by Varian (2009) and Jansen and Spink (2009). More details on the methodology can be found at der-digitale-faktor.de as well as under Google's own explanations (<https://economicimpact.google/methodology/>).

10) The export share is derived from business survey data on the share of revenue from exports.



An estimated 
316 M
store visits
were motivated by
Google Ads in
Germany

Google Ads were also the motivation for an estimated 316 million store visits in Germany, thereby also supporting bricks-and-mortar retail.¹¹

To maintain the momentum of the German economy, there is a need to develop and improve new products, services and business models on a continuous basis. A central role is played here by the deployment of digital solutions. **Some 45 percent of businesses in Germany state that Google applications have had a positive influence on their capability to develop new products, services or business models.** Overall, 54 percent of companies who make use of Google are considered innovators – which means they have launched at least one product or service innovation on the market since 2020.¹² This percentage is more than double the figure for companies not using Google products or services (innovators: 22 percent). Google services also play a highly significant role for the German start-up ecosystem: 138,000 or 85 percent of companies formed last year use Google services. More than 55 percent of start-ups in Germany make use of Android in their company, while 58 percent of

start-ups say that Google's services could significantly reduce the costs of setting up a business.

Alongside its solutions and products, Google is also present in Germany as a company itself, with more than 2,500 employees working at four locations in the country. **Between 2017 and 2022, Google invested around € 1 billion in Germany's digital infrastructure** (Implement Consulting Group, 2023). Google has announced that it intends to invest a further € 1 billion in Germany's digital infrastructure and green energy sector by 2030: in making this investment, it intends to meet demand from German businesses for cloud services while keeping business operations sustainable. Google is also cooperating on research projects with leading German universities and research institutes such as TU Munich, TU Berlin, the German Research Centre for Artificial Intelligence (DFKI) and the Max Planck Society.

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Google invested
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2022

11) The shop visits initiated by Google Ads result from an estimate of the total sales generated in physical retail through Google Ads and an estimate of the average consumer spending associated with a shop visit. A detailed description of the methodology can be found in the full study at der-digitale-faktor.de.

12) In the business survey, companies are defined to be innovators if they have launched at least one product or service innovation since 2020. Innovation is defined as the introduction of a completely new or significantly improved product or service.


€ 53 bn

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For
860,000
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Google Ads and
Google Search

Google's AI-powered services also strengthen the social fabric in Germany

93%

of users view Google Search results as 'useful'

84%

of users view them as 'relevant'

Thanks to the investments made in Germany itself as well as the opportunities for using AI-assisted services from Google, benefits also accrue to German society.

A sizable proportion of the population uses Google services in a wide variety of ways, with Google Search results viewed as 'useful' and 'relevant' by 93 percent and 84 percent of users, respectively.

Faced with a rising cost of living, Google services offer opportunities for making the best of things: the opportunities offered by Google Search to compare prices and products, and to identify shorter and more economical routes using Google Maps, enable consumers in Germany to save an average of € 135 every year.

Products that improve accessibility, such as translation programs or screen readers, can also strengthen the participation of various groups in social life in Germany. Some 61 percent of users of Google's usability tools and accessibility services state that these have improved their quality of life. Older members of society, who can often feel overwhelmed when attempting to use digital devices and the internet (bidt, 2022), also benefit from the use of Google services: a large proportion of citizens in the 51–65 and over-65 age groups also makes use of Google Search at least on a monthly basis. These users also appreciate the intuitive user interface offered by this service, with almost 89 percent of users in each age group considering Google Search to be user-friendly.

Tackling social challenges with AI tools

The potential offered by AI also has a significant role to play within society itself. For many people in Germany, AI is seen as an opportunity for developing targeted solutions to social challenges. The use of AI is supported by:

53%

to reduce carbon emissions

56%

to ensure food security

67%

to improve protection from extreme weather events

41%

to monitor their medical records

58%

to research and develop innovative new medicines

Continuing education is becoming more important and made easier by digital options

Digitalisation and the rising utilisation of AI are changing skill requirements in many professions. An OECD study notes that the deployment of AI goes hand in hand with a need for broader skillsets and a more highly qualified workforce (OECD, 2023). The number of job advertisements mentioning AI is increasing, with skills in data handling now required by more than one in five of these ads (Büchel/Mertens, 2022; Büchel et al., 2023).

The survey results also show that companies intending to increase their use of AI in the future are also planning to offer skills training to their employees and hire additional staff for developing these AI applications. For employees themselves, this means that they can – or indeed must – meet these future demands on their expertise by using continuing education to learn new skills and abilities. In light of the skills shortage, however, companies also have to achieve targeted improvements to their digital competencies.

Straightforward, low-barrier access to training materials can help to improve the readiness to engage with such activities. Google services provide exactly this kind of access, with more than 60 percent of users of Google Search also making use of the service to acquire new proficiencies and know-how. Indeed, over 30 percent of users make use of Google Search to hone their skillset on a weekly basis.

Digital learning can be especially useful to people with lower levels of educational attainment. Among college graduates, just under 11 percent find video-based courses – such as offered by YouTube – easier than textbooks. This figure rises to 15 percent for those with vocational training and just under 17 percent for those with only a school-leaving certificate. Overall, 91 percent of YouTube users make use of the platform as a

source of information and knowledge.¹³

Beyond the use of its services, Google also contributes directly to the educational landscape in Germany: **Since 2014, around 1.9 million people have attended free training courses provided as part of the nationwide 'Google Zukunftswerkstatt' educational initiative.**¹⁴ Google Zukunftswerkstatt provides training materials that help people to acquire and improve their digital skills. At the same time, this initiative helps companies to secure their competitiveness for the future by providing professional continuing education to improve the level of digital expertise in the workforce. In providing this service, Google Zukunftswerkstatt also works with the German Confederation of Skilled Crafts (ZDH) and the German Retail Federation (HDE). **Since January 2022, continuing education courses focusing on AI have also been offered jointly with Fraunhofer IAIS, with 24,000 people having already participated in this training.**

The opportunities outlined above clearly illustrate how digitalisation and Google services can make life easier, while enabling people to make the most of their career prospects and strengthening social participation. This shows the comprehensive and multi-layered social impact that digital applications – and Google services in particular – have in Germany. Respondents consider Google Search, Google Maps, Android and YouTube to be among the top ten most useful innovations of the last 30 years. **Indeed, the value offered to these users by Google services has been priced at a figure of € 109 per month¹⁵** – this is the sum of money that they would need to be paid before they would be prepared to stop using these services. The individual value for Google Search alone is priced at € 65 a month.



1.9 M

people have attended free training courses at the 'Google Zukunftswerkstatt' since 2014

€ 109

per month on average is the value offered to users by Google services

13) Results of a survey by Oxford Economics to assess the economic, social and cultural benefits of YouTube in Germany in 2022, Aug 2023

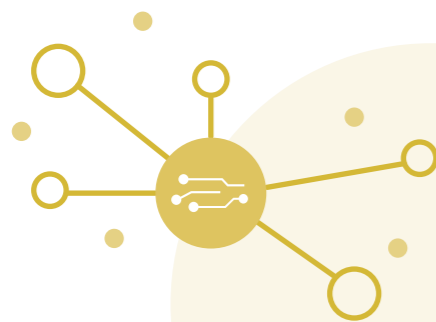
14) Figures provided by Google.

15) The consumer surplus for Google services was determined based on data from the population survey. Respondents were asked to choose between using a Google service (Google Search, Google Maps, YouTube, Gmail or Google Workspace) and a random monetary amount (€1.25, €2.50, €5, €10, €20, €50, €100, €200 and €500). A regression was run on the results for this survey question to derive a demand curve which was then used to calculate the mean consumer surplus per user and product. The calculations were carried out by Public First.

Approaches for leveraging potential

The use of AI and the digital transition in general both offer enormous potential. To ensure this potential is utilised to the full, it is important to broaden access to existing solutions, while developing digital innovations and business models, and working with businesses and civil society actors to investigate new opportunities and pathways to action.

The aim here must be to transition Germany's successful business model, with its well-established and well-developed strengths, into the digital era. Achieving this will require improvements to the general conditions present in Germany while prioritising opportunities for development.



1

An AI hub for SMEs

The survey results show that the utilisation of AI applications in small and medium-sized enterprises is significantly less widespread than in larger companies. An AI hub for Germany, offering a low barrier to entry to case studies and consultancy services, or to applied research, for example, in the context of short learning activities and targeted networking, could alleviate this deficit. A successful example of this is the Centre of Excellence for Skills Retention (KOFA), which helps small and medium-sized companies with strategies for retaining their skilled employees. An AI hub could engage in similar activities for improving the uptake of AI tools.

A first step in this direction has been made with the AI trainers funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK) in the SME 4.0 Centres of Excellence, who provide introductions to the topic of AI with workshops, presentations and in-house visits. An application-oriented AI hub would permit a significantly stronger focus to be directed onto this topic, which would reflect its importance for future developments while also complementing existing programmes.

2

Low-barrier access to digital education

Personalised learning with digital media makes it possible to address the interests and skillsets of individual students. Greater effort should be made to integrate these aspects into teaching in order to accommodate different learning styles. The content mediation offered by various media types and approaches such as gamification should also be used.

By further extending the reach of study platforms, which can be used by pupils as a free and low-barrier means of access to extracurricular learning, steps can also be taken to strengthen equal participation in the German educational system. To ensure that these study platforms offer the right learning content and formats for each and every pupil, AI could be deployed with the aim of analysing learning styles and recommending tailor-made content to users.



3

Expanding HEI excellence and targeting support for AI research

Research is fundamental to both innovation and company formation: in per-capita terms, start-ups are more plentiful in university towns. As many university rankings have shown, however, German higher education institutions have yet to make the grade in international terms (CWUR, 2023). The German research sector also lags behind in terms of winning new subject specialists in the future-oriented field of AI. **In 2020, Germany offered 125 AI degree courses**, compared with 1,244 in the UK and more than 2,000 in the US (Stanford University, 2023).



To avoid German research falling further behind in international terms, the excellence initiative with universities must be established on a broader and better-equipped basis. To this end, incentives should be created for HEIs to work together with businesses to develop innovations towards market maturity.

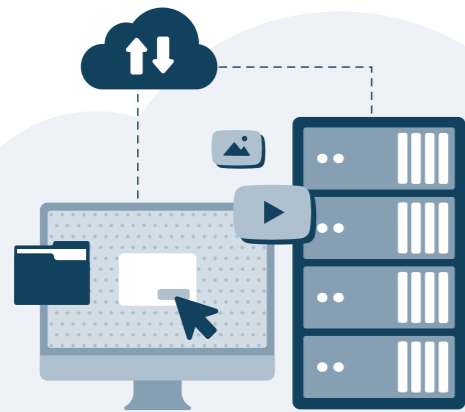
Likewise, there is also a need to increase the number of degree courses in the field of AI, not only with the aim of meeting the increasing demand for specialists in this field but also to support the innovation process itself: a larger number of students acquiring degree-level qualifications in AI would further increase the volume of AI start-ups, if support were to be offered to university spin-offs.

4

Promoting participation in the data economy

Within the production process, the concept of data usage is of extreme economic importance for businesses in Germany. Overall, less than a third of all German companies are able to leverage their data efficiently enough to meet their needs (Büchel et al., 2022). Furthermore, less than half of German businesses participate in data sharing between companies – i.e. they neither use data from other companies in their production processes nor offer access to their own in-house data (Büchel/Engels, 2023).

Uncertainties and obstacles also exist regarding the usage of platforms for data exchange between companies. Here, secure and technically advanced cloud solutions make it easier for companies to utilise their data. To allow SMEs greater access to the potential offered by the data economy, existing SME 4.0 Centres of Excellence in Germany should be expanded and developed with a stronger focus on applications.



5

Promotion of private start-up funding

In Germany, start-ups often face difficulties when it comes to financing. During the first six months of 2023, investment fell by 49 percent year-on-year (Ernst & Young, 2023). High volumes of financing are especially important to digital and high-tech start-ups during their growth phase. A thriving start-up scene is a decisive factor for maintaining a dynamic national economy while also creating innovation stimuli. Venture capital is a key element here: the creation of a 'Private Start-up Fund' could allow Germany's traditional, family-run businesses to cooperate in providing the capital needed for major funding rounds. Initiatives like this are already bringing together start-ups and German SMEs, offering the former the capital and market entry opportunities needed, while allowing the latter to benefit from the innovation stimuli provided. To increase funding volumes here, both financial and non-material incentives are needed to encourage private risk participation.

In a related area, the promotion of start-ups can be strengthened by a social approach termed 'social entrepreneurship'. The study findings show that there is broad support in society for the specific use of AI to resolve social challenges, such as ensuring protection from environmental catastrophes or decarbonisation.



6

A new approach to zoning and permits

Time-consuming approval procedures hinder the development of Germany's economy in many areas, delaying the establishment of new businesses and obstructing expansion projects for renewables or digital infrastructure (cf. Puls/Schmitz, 2022). This is true despite the fact that greenfield investment is a key part of realising the potential of digitalisation due to the optimisation of digital architecture. Setting up new data centres, digital parks and innovation parks is also a critically important step on the way to strengthening Germany's status as a digital nation and creating new innovation activities.

Two decisions can be taken to kick-start the economy here. First, commercial zoning initiatives must be used to address the existing deadlock in creating new zones (IW Consult, 2023). Second, the digitalisation of the German public administration system can accelerate and parallelise approval procedures.



7

Supporting transformation processes in rural areas

As a result of its decentralised strengths and strong manufacturing base, the digital transformation in Germany often plays out in rural spaces. To date, this decentralised distribution of businesses has been advantageous compared with other countries and has strengthened the democratic process in Germany (BDI, 2022). Yet people associate digital processes to some extent with concerns about job security and their personal financial situation. The focus is on risks rather than opportunities. In rural communities, concerns that AI tools will outclass human employees at their own jobs are more widely expressed than in urban areas.

Giving people in peripheral spaces good prospects while granting rural areas more attention in relation to their development is a key aspect of policymaking here, with one fundamental factor being the provisioning of a large-scale, high-performance digital infrastructure – both wired and wireless. In conjunction with the use of pilot areas for digital technologies, new 6G business models and overcoming the friction of distance (by using cloud infrastructure, for example), a series of novel innovation ecosystems could develop in rural spaces. This would strengthen overall confidence that jobs will continue to be created in rural areas as well in the future.

Bibliography

- Acemoglu, D. / Autor, D. / Hazell, J. / Restrepo, P., 2022, Artificial Intelligence and Jobs: Evidence from Online Vacancies, in: Journal of Labour Economics, 40. Jg., p. 293–340
- bidt, 2022, Das bidt-SZ-Digitalbarometer, <https://www.bidt.digital/wp-content/uploads/sites/2/2022/08/Analysen-Studien-bidt-SZ-Digitalbarometer.pdf> [22.08.2023]
- Briggs, Joseph / Kodani, Devesh, 2023, The potentially large effect of Artificial Intelligence on Economic Growth
- Büchel, Jan et al., 2022, Anreizsystem und Ökonomie des Data Sharings. Handlungsfelder des unternehmensübergreifenden Datenaustausches und Status quo der deutschen Wirtschaft, Dortmund/Köln
- Büchel, Jan / Engels, Barbara (2023): Data Sharing in Deutschland, in: IW-Trends, vol. 50, no. 2, pp. 19–37
- Büchel, Jan / Engler, Jan / Mertens, Armin, 2023, The Demand for Data Skills in German Companies: Evidence from Online Job Advertisements, in: EconPol Forum, No. 24, p. 56–61
- Büchel, Jan / Mertens, Armin, 2022, KI-Bedarfe in Deutschland. Regionale Analyse und Entwicklung der Anforderungsprofile in KI-Stellenanzeigen. Gutachten im Auftrag des Bundesministeriums für Wirtschaft und Klimaschutz, Berlin
- CWUR, 2023, World University Ranking 2023, cwur.org [28.08.2023]
- Ernst & Young, 2023, EY Startup Barometer 2023
- European Parliament, 2020, European Parliament resolution of 12 February 2019 on a comprehensive European industrial policy on artificial intelligence and robotics, https://www.europarl.europa.eu/doceo/document/TA-8-2019-0081_EN.html [16 August 2023]
- Federation of German Industries (BDI), 2022, Transformationsstrategien für besonders betroffene Regionen: Identifizierung und Bewertung
- German Federal Government, 2018, Strategie Künstlicher Intelligenz der Bundesregierung, https://www.bmbf.de/bmbf/de/forschung/digitale-wirtschaft-und-gesellschaft/kuenstliche-intelligenz/kuenstliche-intelligenz_node.html#:~:text=KI%20%2DStrategie%20der%20Bundesregierung,im%20internationalen%20Wettbewerb%20zu%20st%C3%A4rken [29 August 2023]
- German Federal Statistical Office, 2023, statistics for small and medium-sized enterprises
- Implement Consulting Group, 2023, A greener and more digital Germany. Impact report prepared on behalf of Google, forthcoming
- IW Consult, 2023, Economic development agency survey, runs until February 2023.
- OECD, 2023, The impact of AI on the workplace: Main findings from the OECD AI surveys of employers and workers, in: OECD Social, Employment and Migration working papers No. 287
- Puls, Thomas / Schmitz, Edgar, 2022, Infrastrukturmängel: Marode Straßen bremsen Unternehmen aus. press release
- Rusche, Christian et al., 2022, KI-Monitor 2022. Künstliche Intelligenz in Deutschland, Gutachten im Auftrag des Bundesverbandes Digitale Wirtschaft (BVDW) e.V., Berlin
- Schröder, Christoph, 2022, Lohnstückkosten im internationalen Vergleich: Kostenwettbewerbsfähigkeit der deutschen Industrie in Zeiten multipler Krisen, in: IW-Trends No. 3
- Stanford University, 2023, Artificial Intelligence Index Report 2023, https://aiindex.stanford.edu/wp-content/uploads/2023/04/HAI_AI-Index-Report_2023.pdf [28.08.2023]



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